



Biofuels: Whole Turf Algae Polyculture Biofuels

The production and conversion of whole turf algae polyculture maximizes fuels, chemicals and nutrients

New Approach to Algal Biomass Production

Sandia National Laboratories in partnership with the Smithsonian Institute and HydroMentia are pursuing the affordable, scalable and sustainable production of biofuels from benthic algal polyculture turf biomass. The highly productive, easily harvested and dewatered algae is a promising new alternative for achieving higher and more reliable biofuel productivity at reduced costs. In comparison to monoculture planktonic algae, grown in open pond raceways, the infrastructure and operations of polyculture turf algae resemble conventional open field agriculture, allowing for the use of mechanical farm equipment that reduces the energy output required for harvesting and dewatering.

Currently, benthic algal polyculture turf biomass is harvested and converted to fuel intermediates with the Algal Turf Scrubber® (ATS™) systems, a technology invented by Dr. Walter Adey of the Smithsonian Institute to effectively extract nutrients as well as contaminants from surface water. HydroMentia commercialized the technology for use in water treatment applications with numerous multi-scale systems in the US. Utilizing this technology approach creates a dual-use model for cleaning water systems and creating biofuels.

While this technique has many economic benefits that make it a viable solution, the conversion of benthic algal turf to biofuels has many challenges that must be overcome including:

- Characteristically low lipid content that requires the conversion of the whole algae biomass into fuel intermediates
- High nitrogen and ash content that impacts downstream processing into fuel intermediates



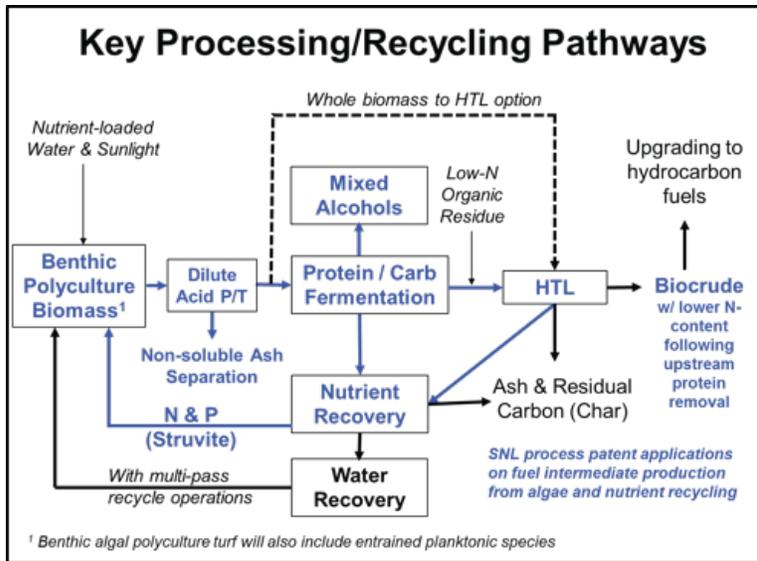
Cultivation, harvesting and dewatering of benthic algal polyculture turf is currently done using the Algal Turf Scrubber (ATS) system developed by Dr. Walter Adey of the Smithsonian Institution and commercialized by HydroMentia.

Sandia researchers are seeking an economical conversion of whole turf algae to biofuels by addressing current challenges including:

- Maximizing fuel production for all the non-ash biomass constituents (proteins, carbohydrates and lipids)
- Reducing the ash content of the produced and harvested biomass
- Increasing the overall biomass productivity for higher yields
- Technology-economics of integrated systems at scale

Investigating Key Processes and Recycling Pathways

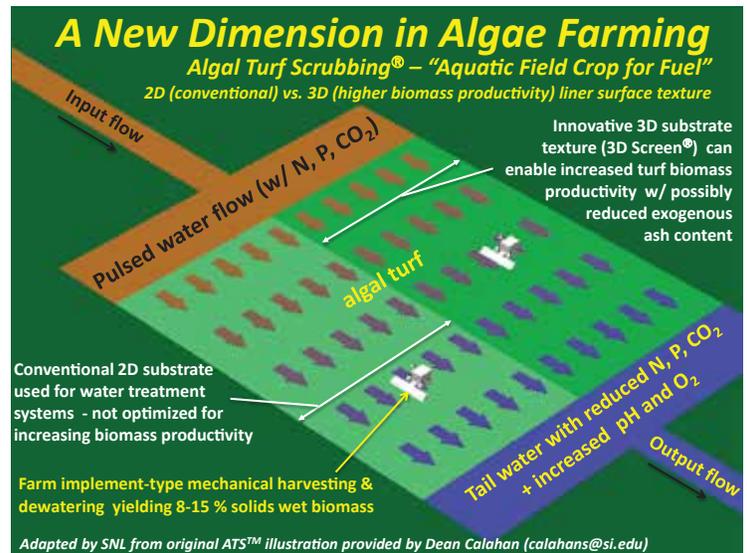
Current research is focused on developing processes to convert the whole turf biomass (proteins, carbohydrates, total lipids) into fuel intermediates using biochemical (hydrolysis and fermentation) and thermochemical (hydrothermal liquefaction – HTL) operations. By leveraging both techniques the entire algae turf can be converted to biomass while removing and recycling nitrogen, phosphorous and water. Further technology research will address ash content by enhancing the cultivation and harvesting system design and operations.



Sandia researchers are investigating key processing and recycling pathways to increase the conversion of all biomass components while containing and recycling nutrients and water. The resulting biocrude is lower in nitrogen making it easier to upgrade to biofuels. This project is currently funded by DOE/EERE BioEnergy Technology Office.

Dual-Use System

The open-field algal polyculture turf cultivation system is dual-use. Utilizing a pulsed, thin turbulent flow across the field, biofuel feedstock is produced at the same time the environmental surface water is cleaned. Innovations in substrate texture, and single pass or multi-pass recycle configurations are showing potential to improve biomass productivity and quality (less ash).



Partnership Opportunities Available

Sandia is leading the effort with current partners, HydroMentia and Smithsonian Institute, to leverage benefits and address challenges in whole turf polyculture algae conversion to biofuels. Contact Sandia for more information on partnership opportunities.

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy
 BIOENERGY TECHNOLOGIES OFFICE



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